

## CHAPTER III - RESEARCH SUMMARY

### 1. GENERAL

One of the four major tasks of the Joint Typhoon Warning Center is to conduct tropical cyclone post-analysis and forecasting research. In most cases research projects are directly concerned with improvements of either speed or intensity forecast of tropical cyclones. Meteorologists from outside agencies such as the Naval Environmental Prediction Research Facility, the Naval Postgraduate School, the 54th Weather Reconnaissance Squadron, and Detachment 1, 1st Weather Wing often collaborate with JTWC on research projects. The following abstracts summarize research completed during the past year. Research ~~underway, but incomplete, is not reported in this section.~~

### 2. TROPICAL CYCLONES AFFECTING GUAM

(Holliday, C. R., FLEWEACEN/JTWC Tech Note 75-3).

A climatology of tropical storms passing within 180 nm of Guam is presented for the period 1948-1975. A review of all typhoons affecting Guam is carried back to 1800 and some noteworthy typhoons of the 1600's are included. The survey encompasses the frequency, behavior, meteorological effects and descriptive chronicles of Guam tropical storms. The major emphasis is on the period since World War II.

### 3. DOUBLE INTENSIFICATION OF TYPHOON GLORIA, 1974, AND A BRIEF REVIEW OF SIMILAR OCCURRENCES

(Holliday, C. R., FLEWEACEN/JTWC Tech Note 76-1).

In November 1974 Typhoon Gloria displayed unusual intensity fluctuations while traversing the Philippine Sea. The typhoon exhibited two marked intensifications separated by a period of weakening lasting 12 hr. A chronological examination of this unusual behavior utilizing aircraft reconnaissance and satellite data is presented with particular emphasis on the evolution of the central core region. A parallel between observed events, and results demonstrated in a tropical cyclone numerical model responding to artificial enhancement of the convective heating functions is noted. Similar occurrences of double deepening of typhoons in the western Pacific are reviewed to determine Gloria's uniqueness.

### 4. A REEVALUATION OF THE CHANGE IN SPEED AND INTENSITY OF TROPICAL CYCLONES CROSSING THE PHILIPPINES.

(Sikora, C. R., FLEWEACEN/JTWC Tech Note 76-2).

The effects of the Philippines on the

speed (transit time) and intensity of tropical cyclone crossings is examined. The Philippines have been stratified into two areas, north and south of 14.5N. Significant differences in speed are found to exist between the two areas, while the intensity profiles are similar to those from an earlier study (Brand, 1972) which indicated that maximum intensities are attained 6-12 hr prior to landfall. In both areas, storm speeds generally decrease to a minimum 12-24 hr prior to landfall and then increase significantly as storms accelerate across the Philippines.

### 5. AN INVESTIGATION OF EQUIVALENT POTENTIAL TEMPERATURE AS A MEASURE OF TROPICAL CYCLONE INTENSITY.

(Sikora, C. R., FLEWEACEN/JTWC Tech Note 76-3).

Several investigators of tropical and mid-latitude sounding data have attempted to differentiate between the "disturbed" and the "undisturbed" states of the atmosphere. Although small temperature differences and relatively large and variable moisture differences are observed, these two parameters still do not adequately describe the varying energy states. The total energy of a parcel of air may be closely approximated by the equivalent potential temperature ( $\theta_e$ ) and the total static energy ( $\sigma$ ), which are highly conservative with respect to both saturated and unsaturated adiabatic processes.

Sounding data from Clark Air Base in the Republic of the Philippines and tropical cyclone dropsonde data have been analyzed for  $\theta_e$ . It is shown that a mid-tropospheric minimum in total energy vanishes as a tropical cyclone approaches Clark Air Base, with subsequent increases in  $\theta_e$  extending through 400 mb. From an analysis of dropsonde data obtained in tropical cyclone centers, large values as well as rapid increases in  $\theta_e$  are observed near 700 mb for those tropical cyclones which are deepening explosively. Since these changes in  $\theta_e$  are not the result of synoptic scale motions nor horizontal advective processes, it is proposed that they are the result of the direct mechanical lifting of heat and moisture in the form of convective "hot towers". Using these values of  $\theta_e$ , a procedure for forecasting the explosive deepening of tropical cyclones is proposed.

### 6. MODIFIED TWENTY-FOUR HOUR EXTRAPOLATION AS A FORECAST TECHNIQUE FOR THE MOVEMENT OF TROPICAL CYCLONE

(Sikora, C. R., FLEWEACEN/JTWC Tech Note 76-4).

Twelve-hour extrapolation (XTRP) and the TYFOON analog program are the most successful objective techniques used by JTWC for forecasting the movement of tropical cyclones. The critical parameters for both

techniques are the current warning position and the past 12-hr warning position. However, during operational use of these techniques it was observed that these positions based on later data had to be frequently readjusted.

It is proposed that 24-hr extrapolation technique (XT24) based on reconnaissance positions preferably from the same reconnaissance platform, is more realistic: (1) these data are real-time whereas the warning positions are merely extrapolated from the reconnaissance positions and (2) a 24-hr period tends to smooth out erratic short-term movements in the storm track. This technique was applied to 15 typhoons from 1974 and 2 typhoons from 1973. Since initial results were encouraging, an operational evaluation of XT24 was conducted during the 1975 tropical cyclone season.